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COLLIERS AND COLLIERY EXPLOSIONS.

Coal Pits and Pitmen. A Short History of the Coal Trade, and the Legislation affecting it. By R. Nelson Boyd, M.Inst.C.E. (London: Whittaker and Co.)

AS the author remarks in his preface, his present work is a re-cast of a book published for him in 1879 by W. H. Allen and Co., under the title of "Coal Mines' Inspection." A casual examination of both books shows that they are alike in their main features; only, the latter work has been extended so as to include some of the events of later years. The subject is divided into twelve chapters, to which are added four short appendices and a good index. The text extends to 239 pages 8vo of good readable print, and there are a few good illustrations of ancient mechanical arrangements, including the steel mill.

Mr. Boyd begins by giving a very short historical account of the situation before Parliament began to interfere in the relations between masters and men. He then describes the circumstances which led to the appointment of successive Royal Commissions, charged to inquire into various matters relating to mines and miners, and he sketches briefly the leading features of the reports presented by these Commissions, together with the chief points of interest contained in the legislative enactments which were founded upon some of them. Our author also pauses from time to time to recount in considerable detail the events of more than passing interest, such as explosions, inundations, and other accidents which happened during the period with which he is dealing; and lastly, in his appendices, he gives the titles of the Acts of Parliament affecting coal mines and miners, both English and Scotch, a list of serious colliery explosions previous to and since 1850, and a table showing the production of coal at different times, commencing in 1660, and brought down to 1891.

Among other more or less important provisions of the Acts of Parliament our author gives prominence to:—The exclusion of women from mines, the appointment of Government inspectors, the limitations of the ages at which boys can be employed, the restrictions under which explosives may be used, the requirement that each mine should have two distinct shafts, that each mine manager must have a certificate similar to that of a sea captain, that payment must be made by weight and not by measure, the conditions under which safety lamps are to be used, and the method of dealing with coal-dust when it is present.

He also reviews such questions as the payment of royalties and wayleaves to landlords, the employers' liability, the wasteful consumption of fuel, the duration of the coal supplies, and old-age pensions to miners.

Contrasting the present with the past he says:—"The workmen of the present day have attained a distinct social position, have representation in the House of Commons, and trade unions, societies, and powerful combinations," whereas formerly the Scotch colliers were *adscriptæ glebæ*, that is, were bought and sold with the land: an Act of the Scotch Parliament of 1660 prohibited them from leaving their employment without a written attestation from their masters under pain of punishment in their bodies, and any person employing them was ordered to return them within twenty-four hours or pay a fine of one hundred pounds Scots. The colliers of the North of England were little better, being hired by the year under a system of binding or bonding; those of the Bristol coal-field were described by contemporary writers as being as brutal and ignorant as savages. Colliers lived apart from the rest of the community, were looked down upon with contempt by their fellow-men, and diverted themselves with bull-baiting, drinking, and debauchery.

The state of serfdom was removed by various Acts of Parliament passed during the latter half of last century, apparently more with the object of increasing the numbers of the colliers by drawing other classes of labourers into the mines than from any specially humanitarian motives. But at length a day dawned when higher principles began to prevail. From 1842, when Lord Ashley's Act was passed for the exclusion of women from the mines, onwards to 1887, one Act was passed after another, each having the same object in view, namely, the amelioration of the lot of the miner.

The frequent occurrence of disastrous colliery explosions and the great destruction of life and property which accompanied them, had done more than anything else to draw the attention of the public to a consideration of mining affairs, and had likewise been the principal incentive to the appointment of Royal Commissions and to the passing of Acts of Parliament to regulate the supervision and the working of mines.

Notwithstanding all that had been done previously, more lives were lost in explosions during the five years ending 1870 than during any preceding five years, the aggregate number lost in fifteen explosions, each of which involved the loss of ten lives and upwards, having amounted to 923.

The Coal Mines' Regulation Act of 1872 was drawn up with great care by Mr. Bruce (now Lord Aberdare), the Home Secretary. It embraced the experience of the Inspectors of Mines, as well as the combined wisdom of mine owners, engineers, managers of mines, and delegates of the colliers. But, firedamp having been hitherto regarded as the sole cause of colliery explosions, the stringent provisions of that Act were directed exclusively towards the detection and removal of that element of danger.

In 1845 Messrs. Lyell and Faraday, who had examined the scene of the Haswell colliery explosion, which they attributed to large accumulations of firedamp in the empty spaces (goaves) from which pillars had been removed, remarked that firedamp had not been its only fuel, but that doubtless the coal-dust which was raised and swept along *by the firedamp flame* would be decomposed by the heat of that flame, and would therefore add to the force of the explosion.

Between the years 1860 and 1875 several French mining engineers were impressed with the idea that coal-dust had played a part in certain explosions which took place in France. Some experiments were made by a committee of the Société de l'Industrie Minérale, and by M.

Vital, one of the Ingénieurs des Mines, with the object of ascertaining the likelihood or otherwise of this hypothesis, but no definite conclusions were arrived at.

In December, 1875, the present writer examined into all the circumstances attending a colliery explosion in South Wales, and gave a minute description of it before a coroner's jury. He insisted that coal-dust had been the principal agent in that explosion, and that firedamp had only played a subordinate part. At the same time he referred to the results of experiments he had made which showed conclusively that when fine dry coal-dust is added to a mixture of air and firedamp, in which the firedamp is present in so small a proportion as to escape detection by the means employed for this purpose in mines, the mixture is inflammable at ordinary pressure and temperature, and when ignited burns like a jet of inflammable gas. In March, 1876, he read a paper before the Royal Society, in which he described these experiments, as well as the apparatus with which they had been carried out. In this paper, also, he claimed that when an explosion is once begun in a dry and dusty mine it becomes self-propagating, and, provided the continuity of the deposit of coal-dust is unbroken, it extends to the utmost limits of the workings. This became known afterwards as the "Coal-dust Theory of Great Colliery Explosions."

In May, 1876, Mr. Hall, one of the Inspectors of Mines, read his first paper on the subject before a meeting of the North of England Institute of Mining and Mechanical Engineers held in London.

During the year 1878 the present writer published a series of papers on "Coal-dust Explosions" in "Iron"; and while they were appearing Messrs. Marrecco and Morrison read their first paper on the subject.

Numerous societies of mining men, and individuals more or less connected with mining, now began to take an interest in the subject, and to make experiments with coal-dust. About this time, also, Commissions were appointed by the Governments of England (Royal Commission on Accidents in Mines 1879), France (Commission du Grisou), Prussia and Austria, to inquire into the causes of mining accidents, and amongst other things to investigate the probable influence of coal-dust in colliery explosions.

This sudden activity was no doubt quickened by the events of the ten years ending with 1880, during which the loss of life from explosions was twice as great as it had been during any previous decade. Taking into account only those explosions in which ten lives and upwards were lost, we find that there were thirty-five explosions, involving the lives of 2014 persons, of which 1411 were attributable to the second half of the decade.

In 1880 Prof. (now Sir Frederick) Abel, one of the English Commissioners, was instructed by the Home Secretary to investigate and make a special report upon the Seaham colliery explosion (September 8, 1880). During the course of these investigations Abel repeated our experiments of 1875-76 with a similar apparatus with practically the same results as far as coal-dust is concerned; but he claimed in addition to have discovered that any very finely divided incombustible dust would render a mixture of air with 3 or 4 per cent. of firedamp inflammable. His apparatus was not, however, provided with any special means of mixing the gas and air such as had been used in our own apparatus, of which it was otherwise a copy.

The German Commissioners erected and made experiments with an apparatus similar to one that we had described to the Royal Society in 1881, but on a somewhat larger scale, and they obtained similar results. Unfortunately, however, they passed away from the main question, viz. whether an explosion that *has taken place* in a dry and dusty mine under the circumstances that would have been formerly described as mysterious, can be attributed to the influence of the coal-dust in the supposed absence of firedamp?

The French Commissioners arrived at conclusions adverse to the coal-dust theory. They made no special experiments with coal-dust on an important scale and they did not, so far as can be gathered from their reports, examine the workings of any mine immediately after an explosion.

The Austrian Commissioners arrived at the conclusion which we had previously stated in this country, namely, that the relative fineness of a dust has far more to do with its relative inflammability than its chemical composition.

The English Commissioners expressed an oracular opinion. They denied on the one hand that coal-dust could be the principal agent in great colliery explosions, for, "If that were the case," said they, "an explosion would happen every day, nay every hour." But, on the other hand, they endeavoured to point out that coal-dust may be an element of the gravest danger under certain circumstances which they proceeded to define in a very precise manner. The Act of 1887 embodies their recommendations regarding safety lamps, explosives, and coal-dust.

From the end of 1875 onwards attention had been more and more directed to the coal-dust question. It had been observed that a great explosion never by any chance took place in a damp or wet mine, that when such an explosion took place in a dry and dusty mine, its progress was always arrested by dampness or wetness or by the absence of coal-dust, that it always passed through the dry intake airways, which contain pure air, and comparatively clean coal-dust, that it frequently avoided the return airways, which contain all the firedamp produced in the workings, but impure coal-dust or only stone-dust, and, lastly, that it spread into all the districts of the workings ventilated by separate and distinct intake and return airways, quite irrespective of the force or direction of the ventilating currents, and dependent only upon the one simple but indispensable condition that the train of dry coal-dust continued unbroken, or was interrupted only for short distances here and there. These facts were proved to demonstration by the researches of a number of independent observers in the mines themselves, immediately after the occurrence of explosions. In vain have the opponents of the coal-dust theory, who were at one time very numerous, urged that the intake airways might have contained firedamp, that the coal-dust cloud raised and ignited by a local disturbance, such as the firing of a blasting shot, probably acted as a connecting link which carried the flame from one accumulation of firedamp to another, that if coal-dust was as dangerous as it was represented to be, an explosion would take place every day, nay, every hour; that certain kinds of coal-dust were perhaps less inflammable than others, and so on.

Comparatively few have had the advantage of carefully studying the coal-dust flame as well as the opportunity of investigating the minutest details of a series of great colliery explosions in the mines, immediately after their occurrence. The foregoing arguments are therefore perhaps to some extent excusable; but they are none the less the outcome of the imagination of their authors. They are being pressed more and more feebly as time goes on, and they are likely, we think, before many years have passed, to vanish as absolutely as the so-called "outburst of gas" theory which for more than a generation was invariably quoted as the only possible means of accounting for the kind of explosions to which we have been drawing attention.

The late Home Secretary, Mr. Matthews, was so much impressed by the occurrence of great explosions one after the other in dry and dusty mines, that he appointed a Royal Commission on Coal-Dust in 1890. That Commission has not yet issued its report, but the volume of evidence taken before it, which has been lately published, shows to what small proportions the opposition has shrunk since the theory was first started. It is also satisfactory to observe that the number of lives lost in great explosions during the last ten years is only about one half of the number lost during the previous ten years.

W. G.

REVERIES OF A NATURALIST.

Idle Days in Patagonia. By W. H. Hudson, C.M.Z.S., Author of "The Naturalist in La Plata." (London: Chapman and Hall, 1893.)

THE title of this book well describes its contents; but Mr. Hudson has established so high a standard by his previous work that the present volume has something of the character of an anti-climax. In literary style, in picturesque description, and in suggestive ideas and reflections there is no falling off; but we miss the wealth of original observation and ingenious speculation which made "The Naturalist in La Plata" a masterpiece.

Mr. Hudson was wrecked on the shores of Patagonia, and had a weary tramp over the desert, of some thirty miles, to reach the settlement on the Rio Negro. There, and at some farms higher up the valley, he appears to have spent a year or more, doing nothing but wandering about on foot or on horseback, observing the habits and peculiarities of the scanty fauna and flora, noting the varied aspects of nature, and apparently thoroughly enjoying day after day of dreamy idleness. He spent some months at a house about seventy miles up the valley, which was here about five miles wide; and every morning he rode away to the terrace or plateau, covered with grey thorny scrub, and there found himself as completely alone as if he were five hundred instead of only five miles from civilisation. He says:—

> "Not once, nor twice, nor thrice, but day after day I returned to this solitude, going to it in the morning as if to attend a festival, and leaving it only when hunger and thirst and the westering sun compelled me. And yet I had no object in going—no motive which could be put into words; for although I carried a gun, there was nothing to shoot—the shooting was all left behind in the valley. Sometimes a dolichotis, starting up at my approach, flashed for one moment on my sight, to vanish the next moment in the continuous thicket; or a covey of tinamous sprang rocket-like into the air, and fled away with long wailing notes and loud whirr of wings; or, on some distant hillside a bright patch of yellow, of a deer that was watching me, appeared and remained motionless for two or three minutes. But the animals were few, and sometimes I would pass an entire day without seeing one mammal, and perhaps not more than a dozen birds of any size."

There was nothing beautiful or even pleasing to be seen in this dreary monotonous solitude, yet he felt a great delight and satisfaction in it, which he imputes to the ancestral savage nature that still exists in all of us, though repressed and overlaid by civilisation and society.

> "It was elation of this kind, the feeling experienced on going back to a mental condition we have outgrown, which I had in the Patagonian solitude; for I had undoubtedly *gone back;* and that state of intense watchfulness, or alertness rather, with suspension of the higher intellectual faculties, represented the mental state of the pure savage."

In the second chapter—"How I became an Idler" we are told of a still more disagreeable adventure than the shipwreck. Mr. Hudson was going with a friend to a farm eighty miles up the valley. On the way they stayed a night at a deserted hut, and here he had the misfortune accidentally to discharge a revolver bullet into his knee, rendering it necessary for him to return to the settlement to be cured, perhaps to save his life. His friend tied up the wound as well as he could, and left him to get a cart from the nearest house a good distance off. He was absent a whole day, Mr. Hudson lying on his back on the ground all the time. When his companion at length returned with the cart, and lifted him up to put him into it, a large and very poisonous snake moved from under his cloak, where it had been lying close to his feet for many hours. It glided away into a hole under the wall, and Mr. Hudson rejoiced "that the secret deadly creature, after lying all night with me, warming its chilly blood with my warmth, went back unbruised to its den."

This accident kept the author for some months in bed, and for other months a convalescent unable to walk far; and thus the finest summer weather was wasted, and he acquired those habits of the country and the people that made him an idler, and prevented him from learning as much of the animal and vegetable life of the country as, under more favourable circumstances, he might have done. Yet he gives us many interesting facts and discussions, and the chapter on "The War with Nature" is one of these. This war begins when man introduces domestic cattle, cultivates the soil, and destroys the larger wild animals for food or sport. In doing this he provides food of an attractive kind for many wild creatures, and the war begins. Pumas devour his cattle; locusts destroy his grass or crops; coots, ducks, geese, or pigeons devour the grain as soon as sown, or feed upon the young shoots, or upon the ripe wheat ready for the harvest; and thus the farmer is kept in a constant state of activity and watchfulness, which really gives him a beneficial excitement in what would otherwise be a most